Neotectonics of the Dixie Valley Geothermal Field and Models For Late Holocene Static Stress Redistributions

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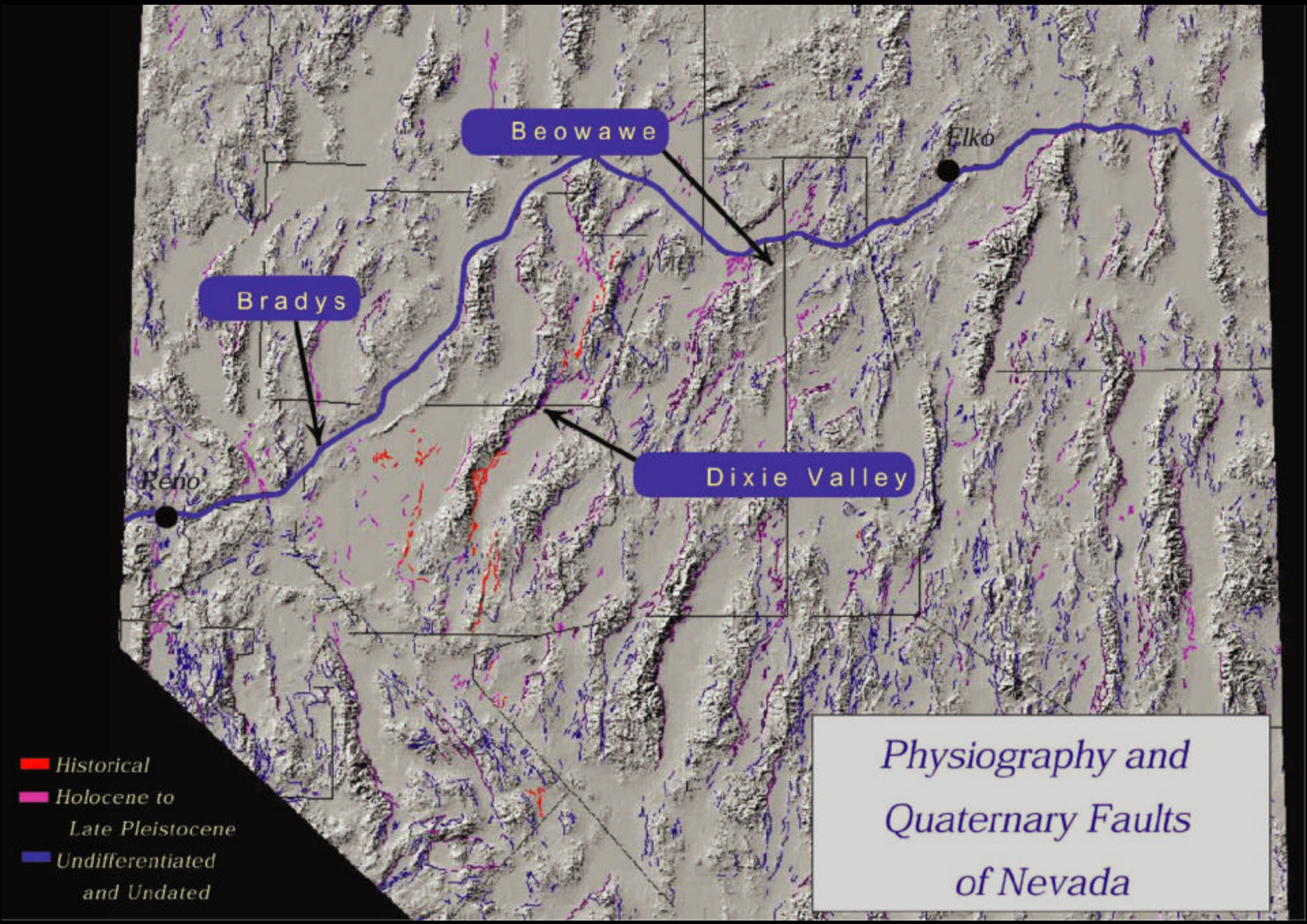
Back to Agenda



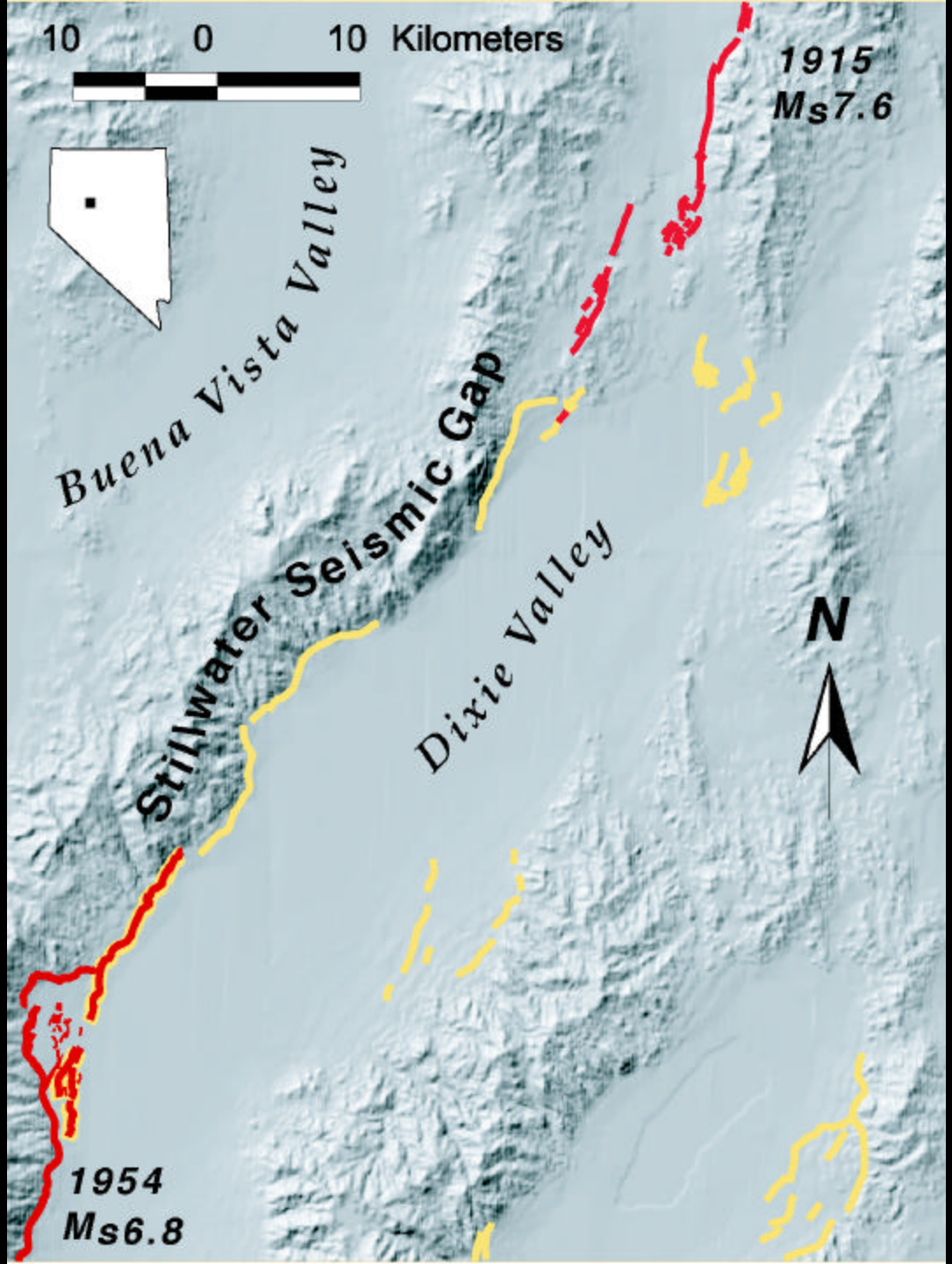
faults after Dohrenwend et al. (1996)

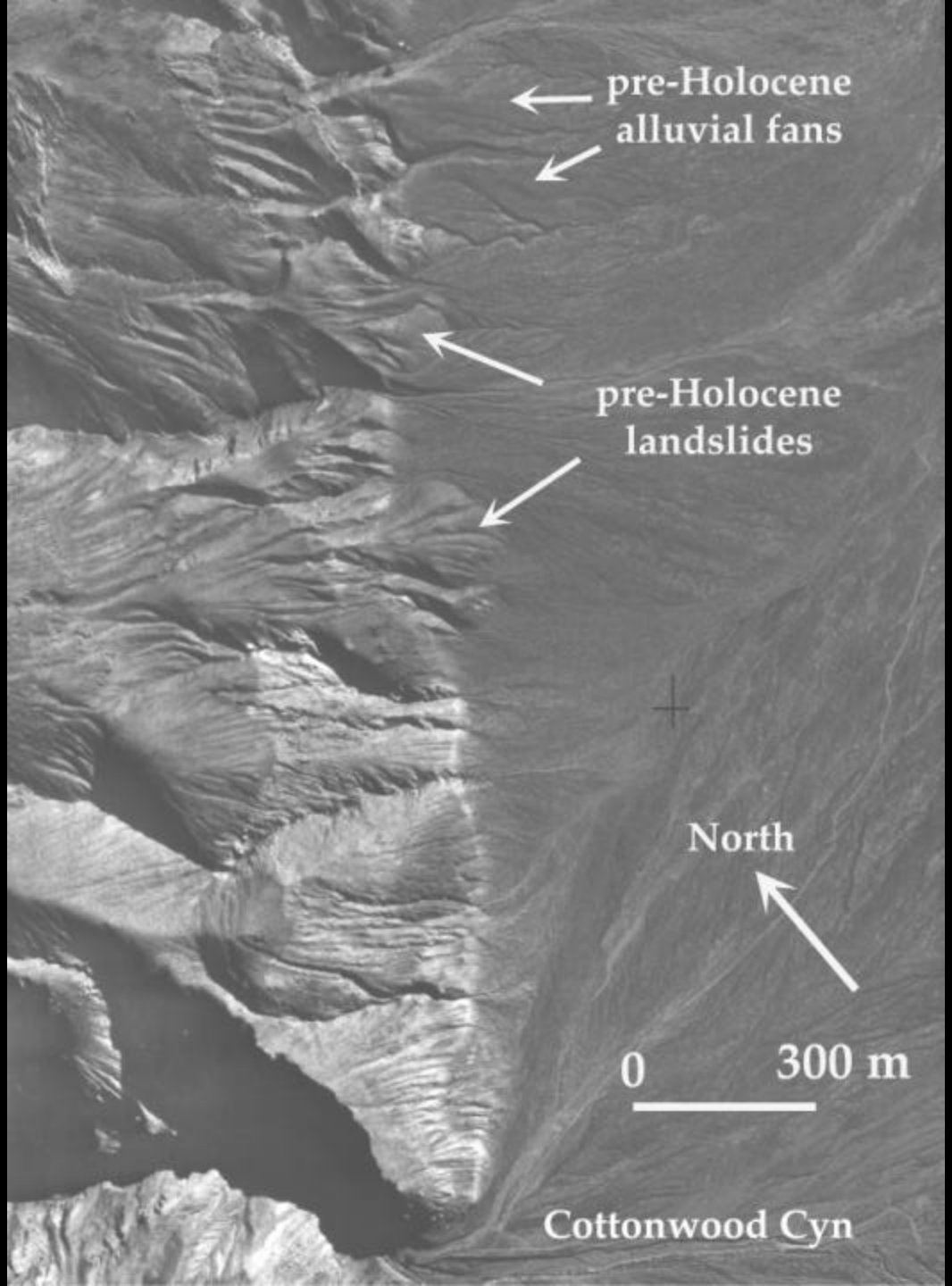
Objective:

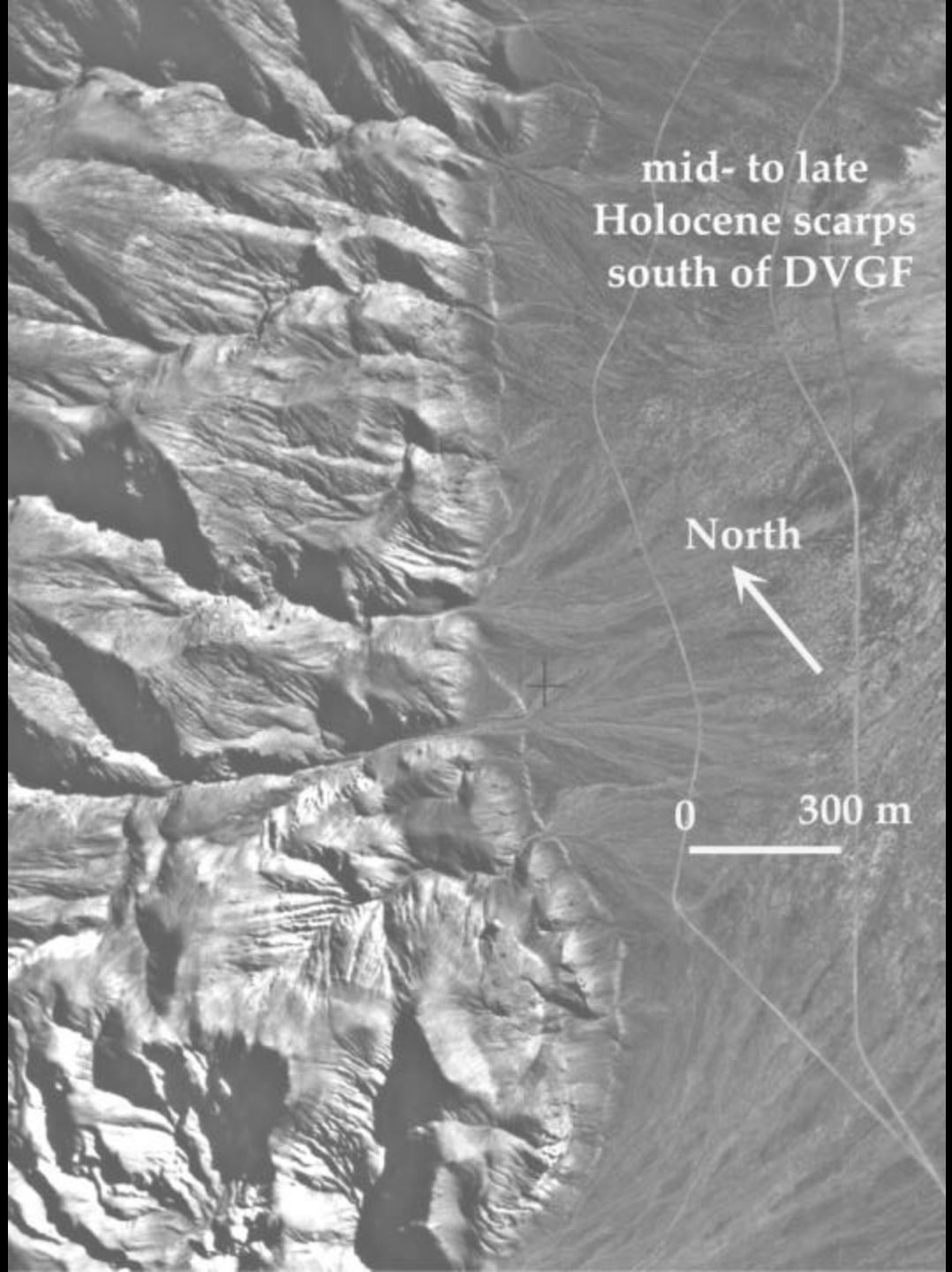
- to gain a better understanding of how the mechanics of the the faulting process may influence the state of stress and fracture permeability in geothermal fields

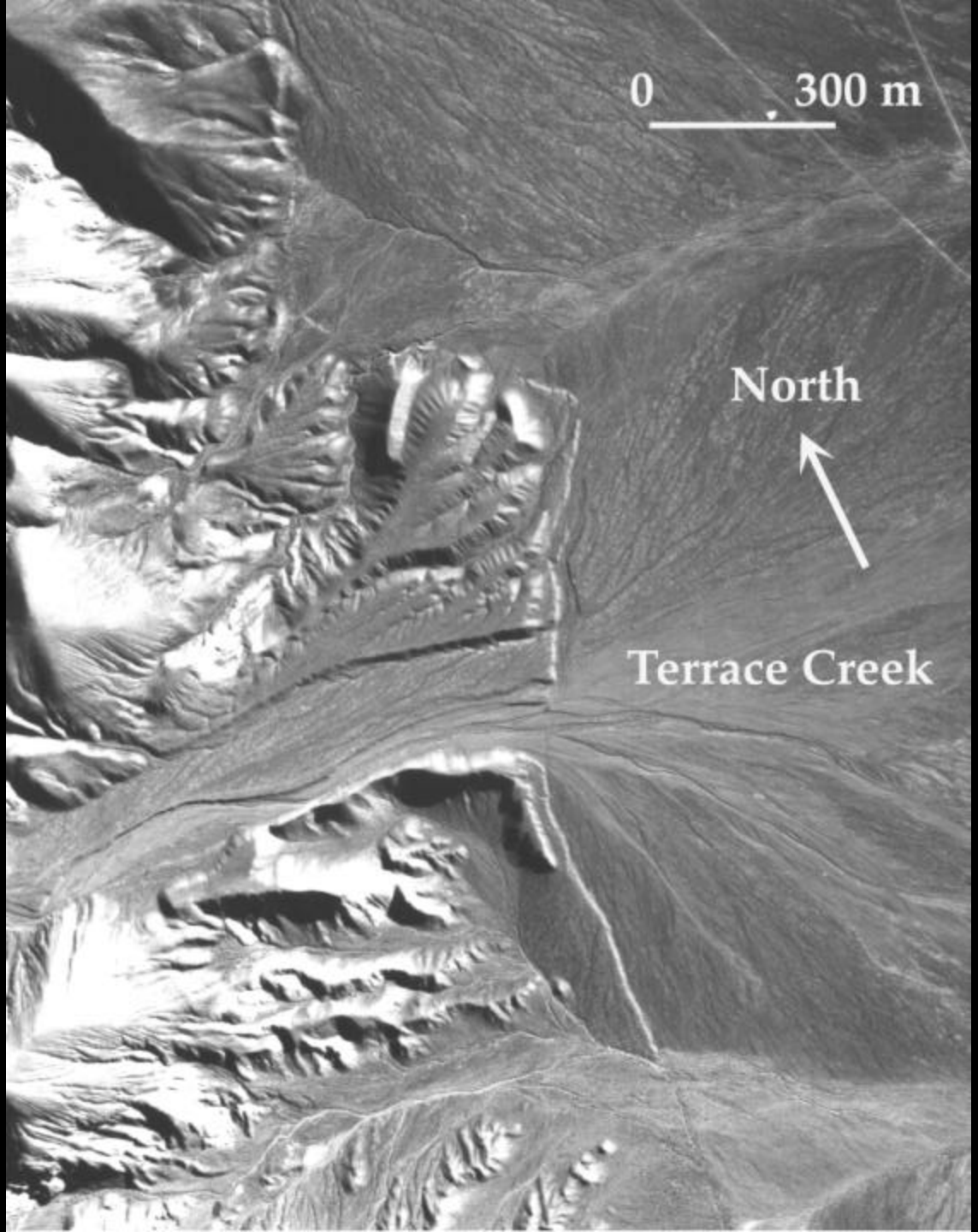
Goal:

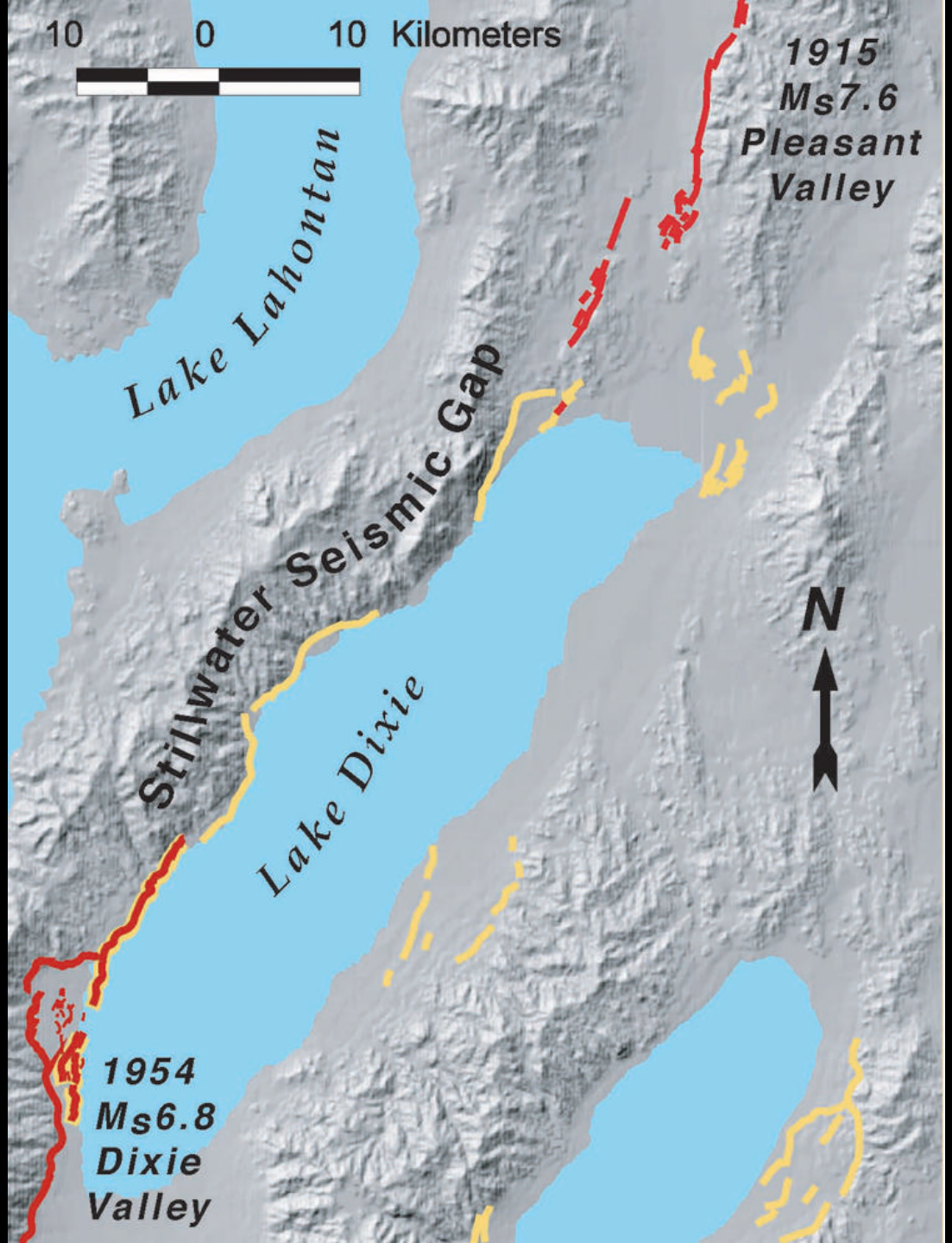
- to apply this knowledge to geothermal exploration

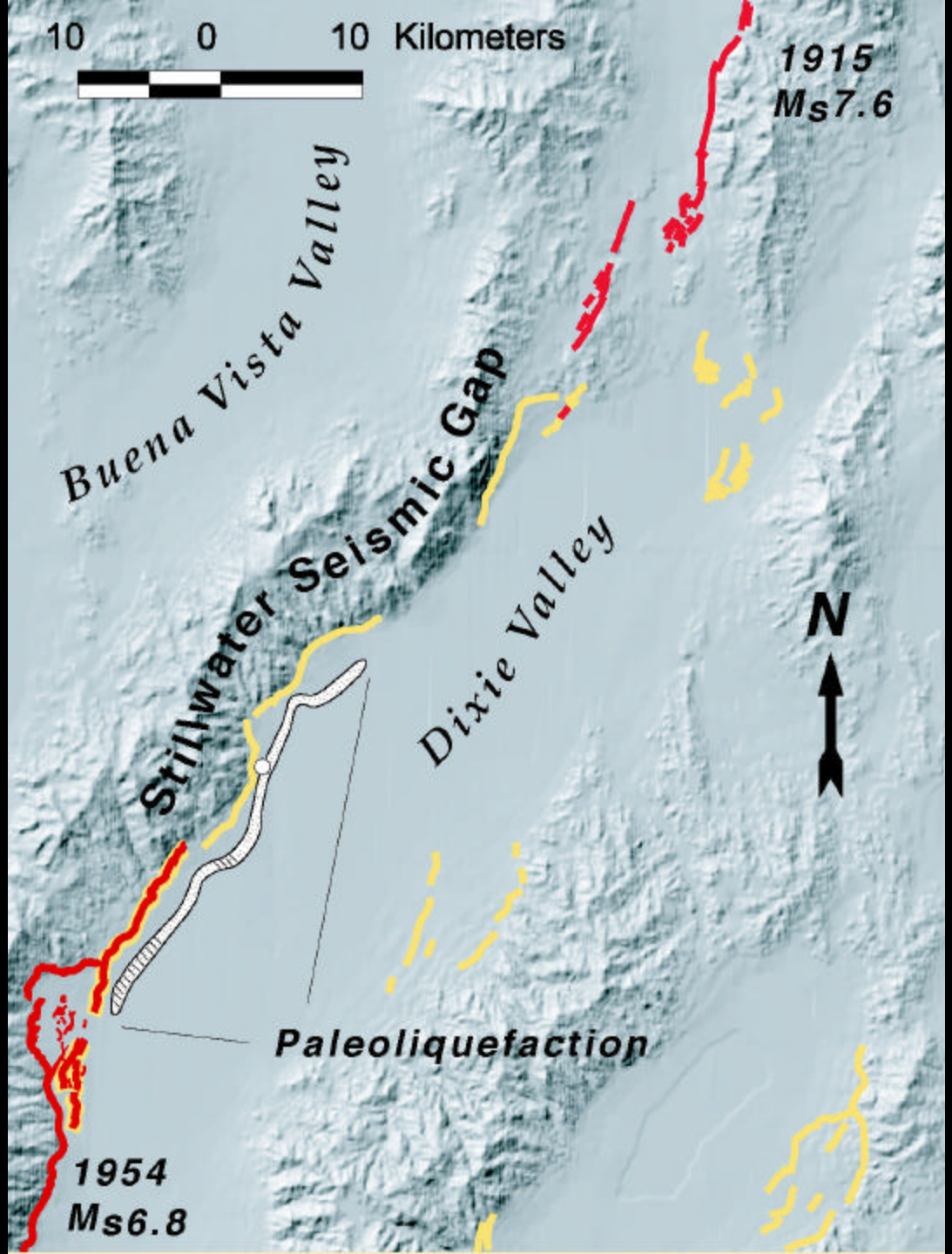

10 0 10 Kilometers
1915
Ms7.6
Buena Vista Valley
Stillwater Seismic Gap
Dixie Valley
N
1954
Ms6.8

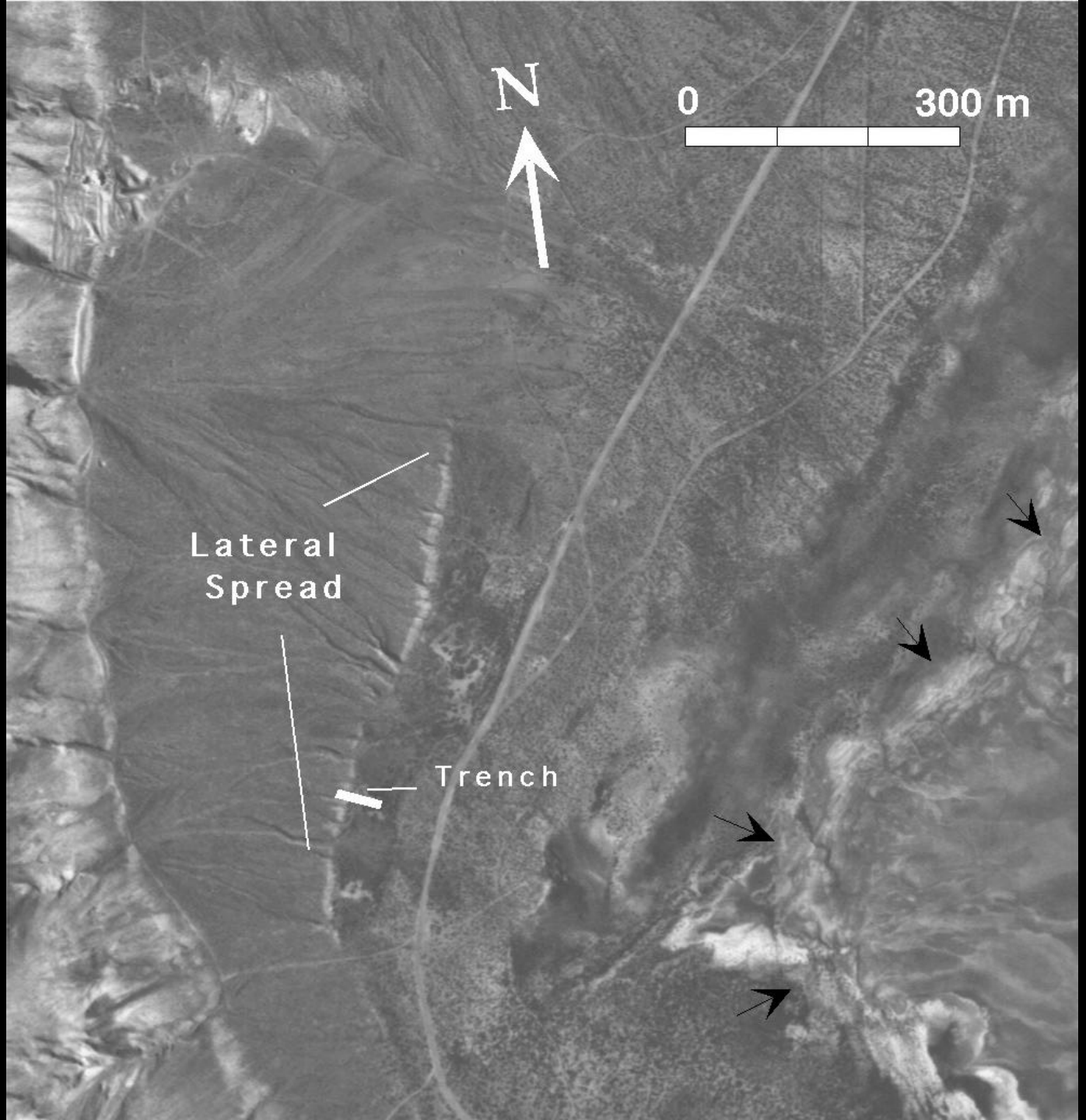

pre-Holocene
alluvial fans
pre-Holocene
landslides
North
0
300 m
Cottonwood Cyn

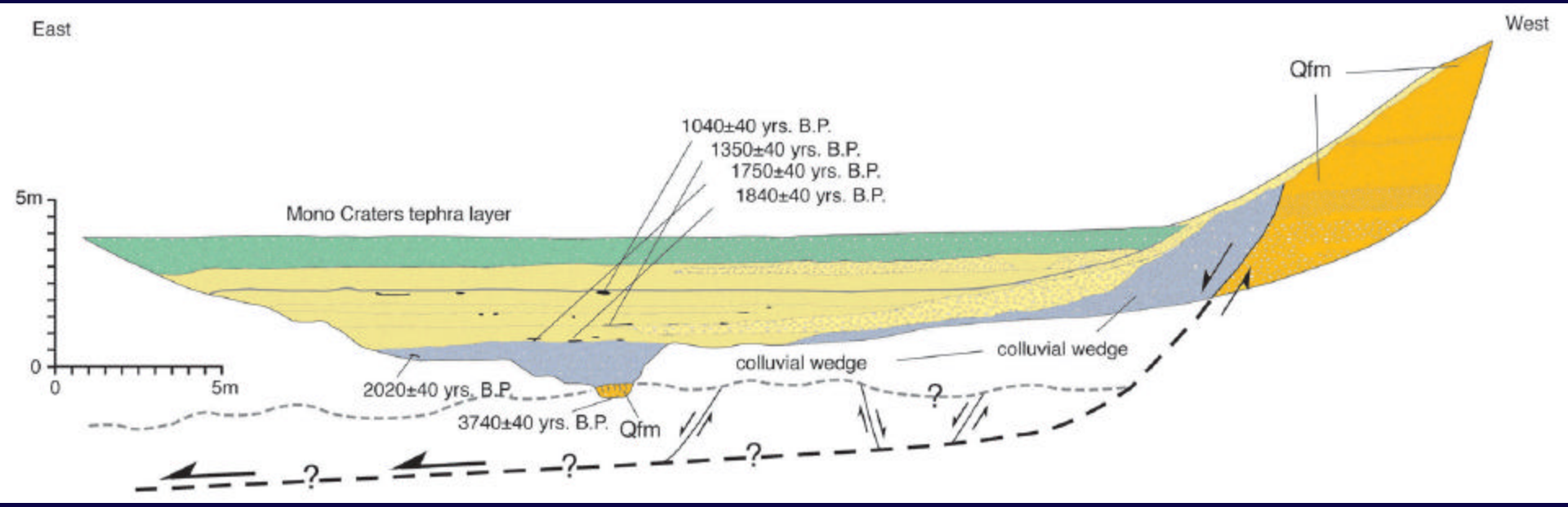

mid- to late
Holocene scarps
south of DVGF
North
0
300 m

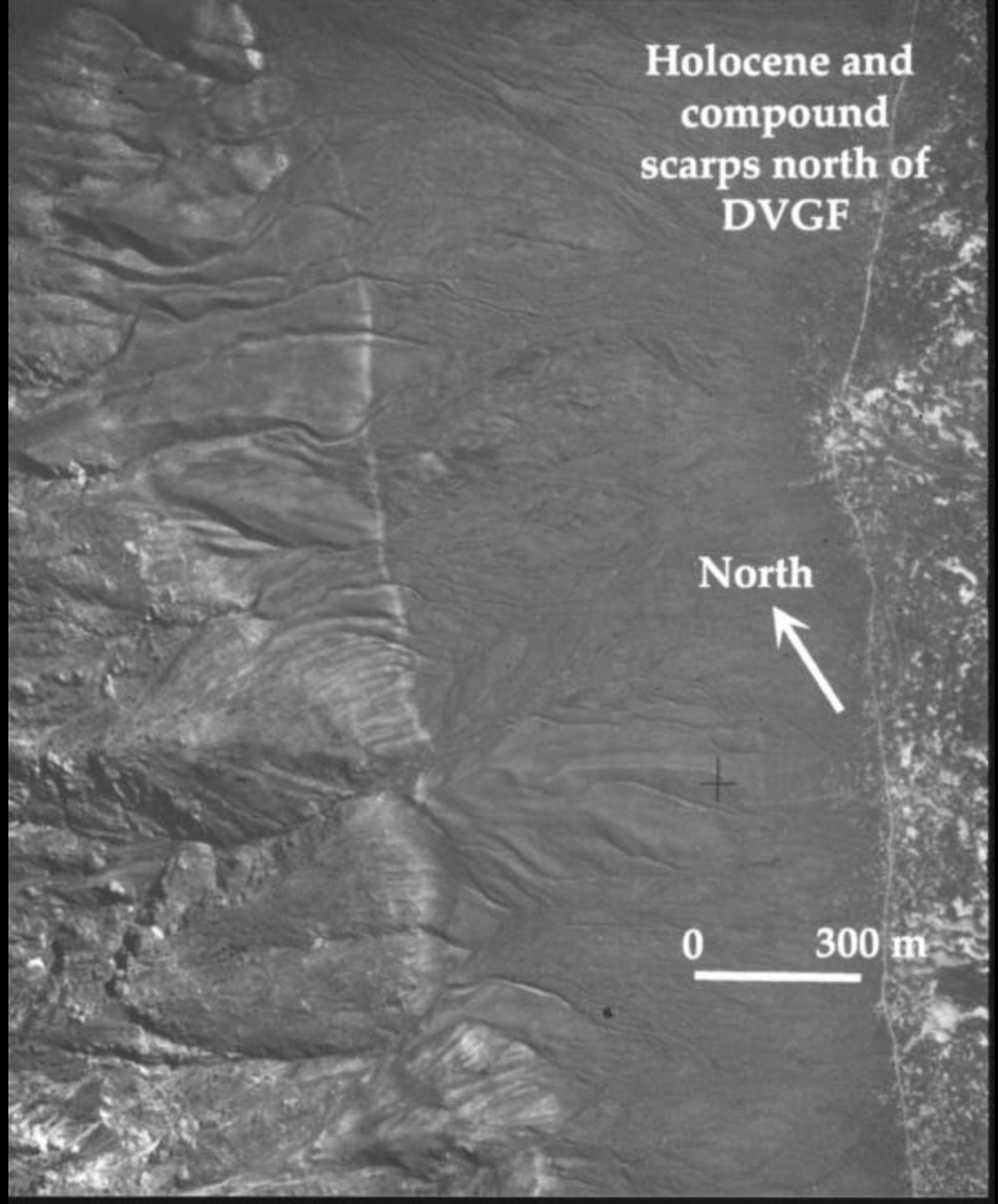

0
300 m
North
Terrace Creek


10 0 10 Kilometers
1915
Ms7.6
Pleasant
Valley
Lake Lahontan
Stillwater Seismic Gap
Lake Dixie
N
1954
Ms6.8
Dixie
Valley

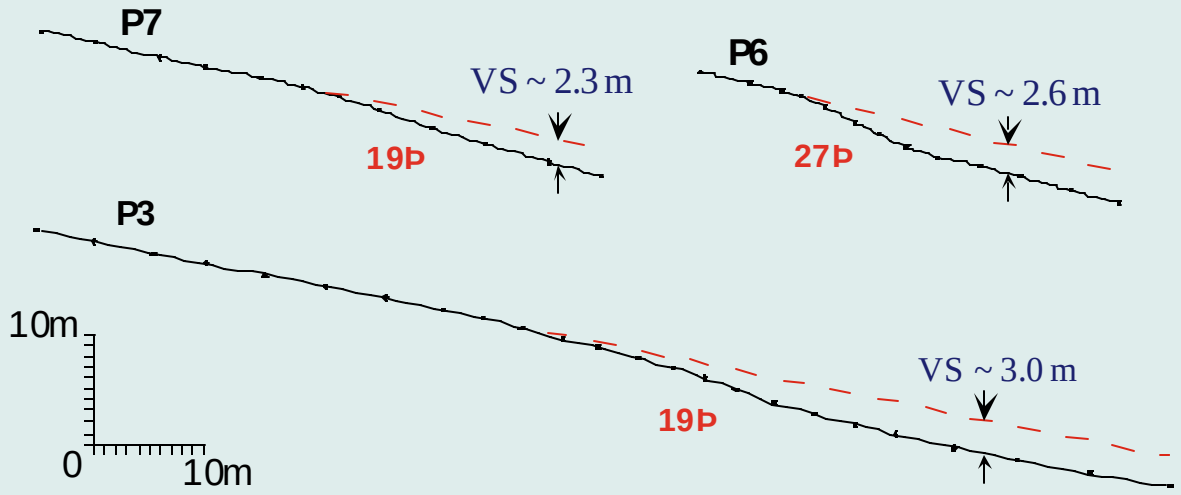

10 0 10 Kilometers
1915
Ms7.6
Buena Vista Valley
Stillwater Seismic Gap
Dixie Valley
N
Paleoliquefaction
1954
Ms6.8


N
0
300 m
Lateral
Spread
Trench

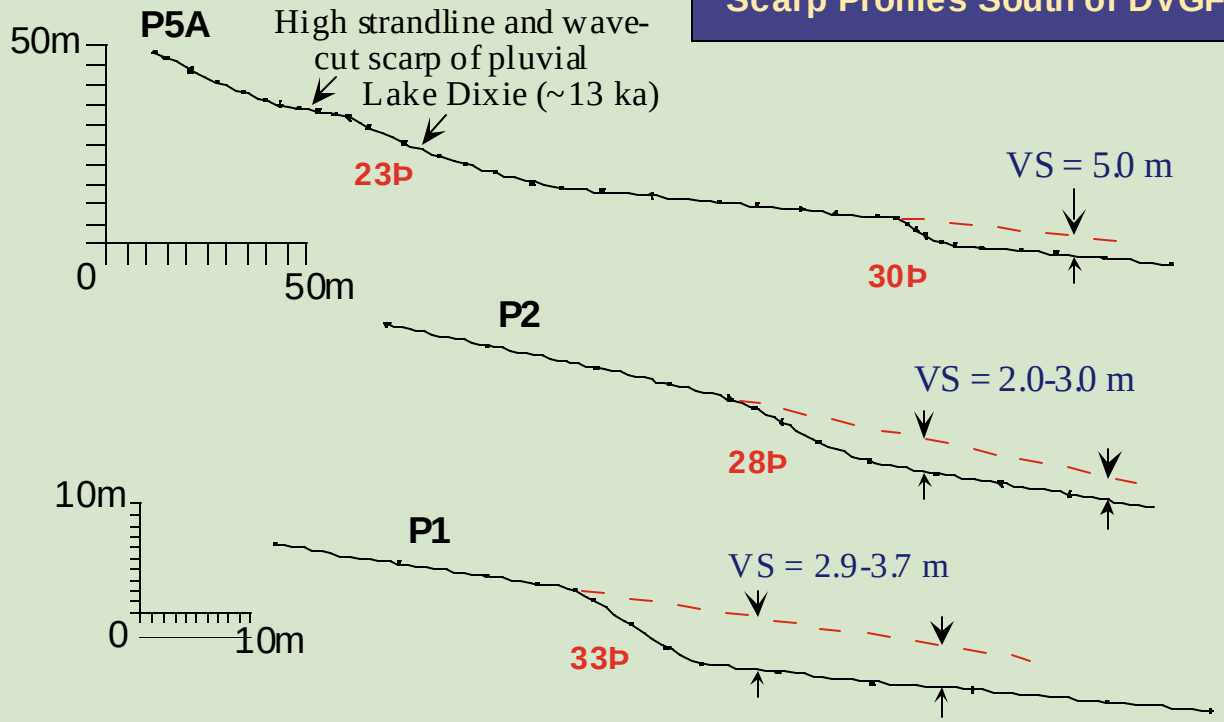

East
West
Qfm
1040±40 yrs. B.P.
1350±40 yrs. B.P.
1750±40 yrs. B.P.
1840±40 yrs. B.P.
5m
Mono Craters tephra layer
0
0
5m
colluvial wedge
colluvial wedge
2020±40 yrs. B.P.
3740±40 yrs. B.P.
Qfm
?
?
?
?

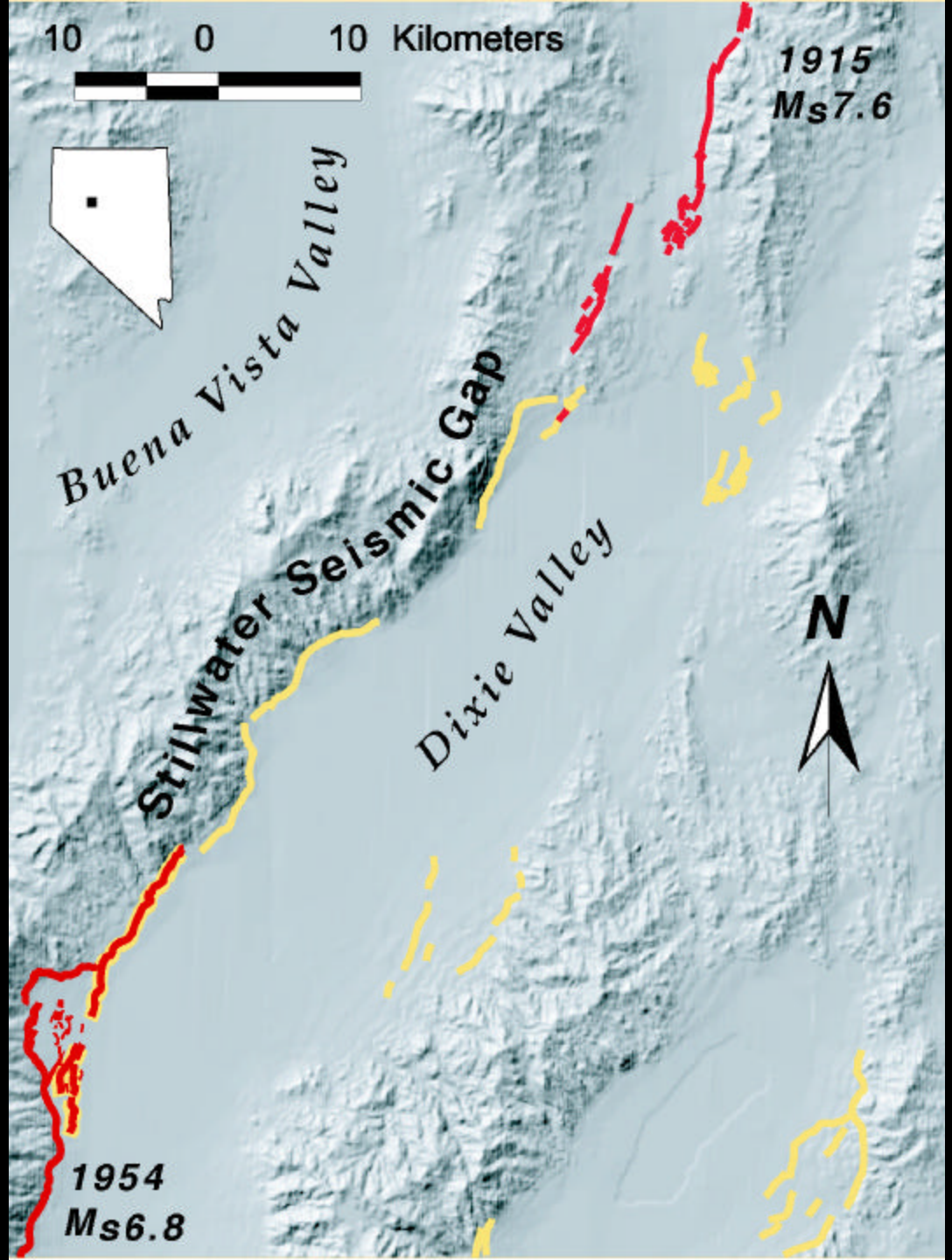

Holocene and
compound
scarps north of
DVGF
North
0
300 m

Scarp Profiles North of DVGF



Scarp Profiles South of DVGF




10 0 10 Kilometers
1915
Ms7.6
Buena Vista Valley
Stillwater Seismic Gap
Dixie Valley
N
1954
Ms6.8

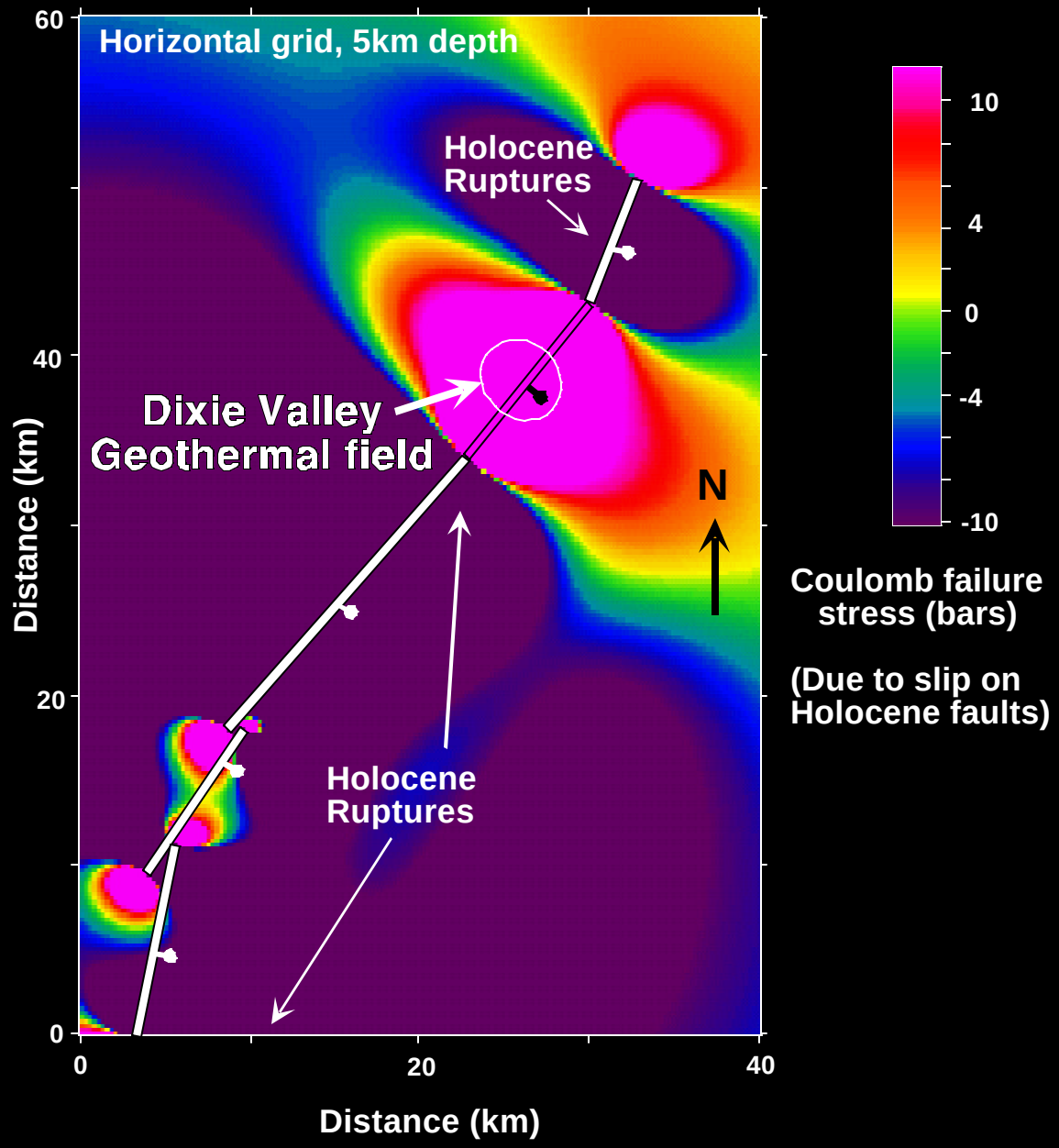
Coulomb Failure Function

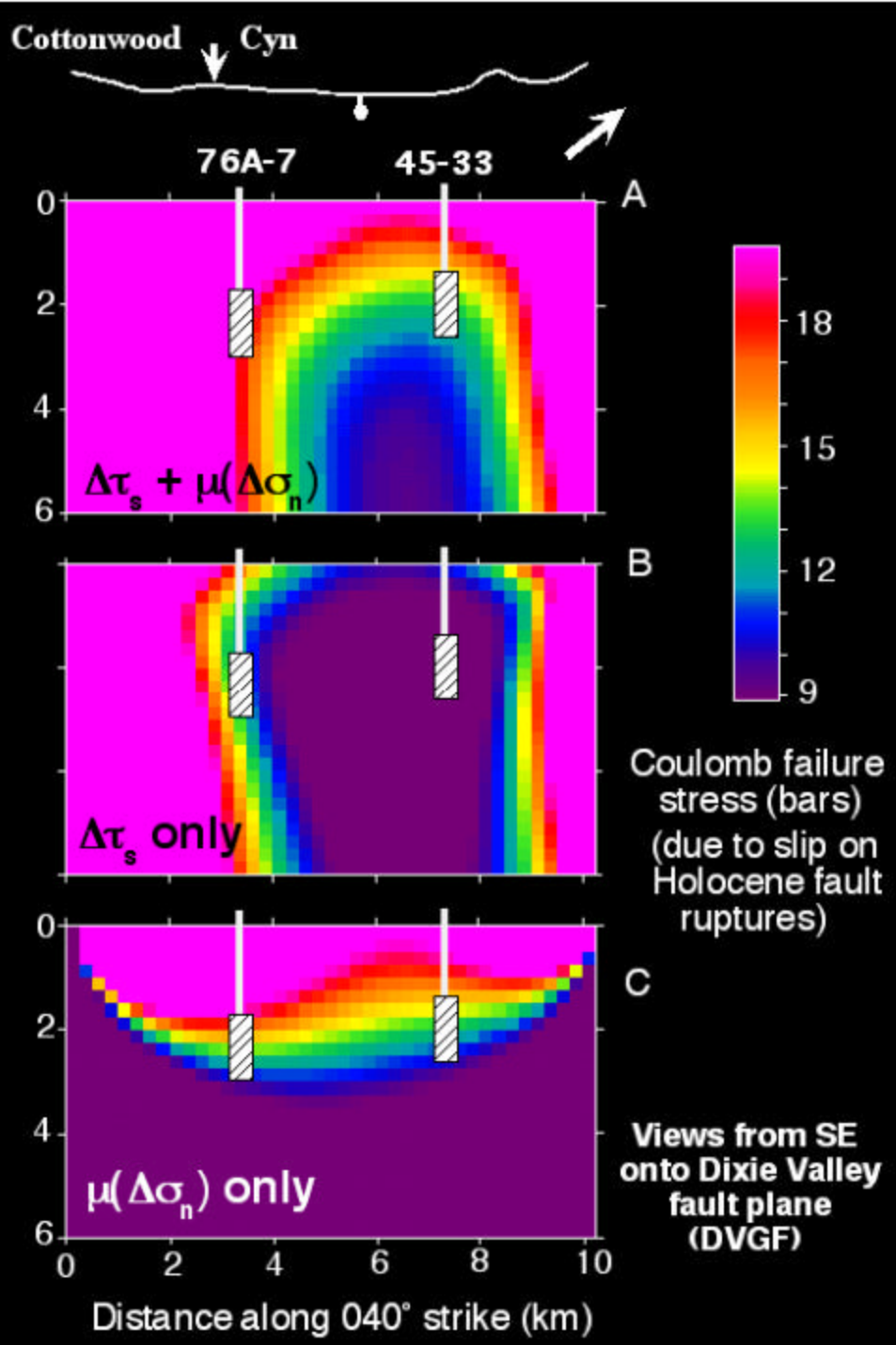
$$\Delta CFF = \Delta\tau_s + \mu_s(\Delta\sigma_n + \Delta P_f)$$

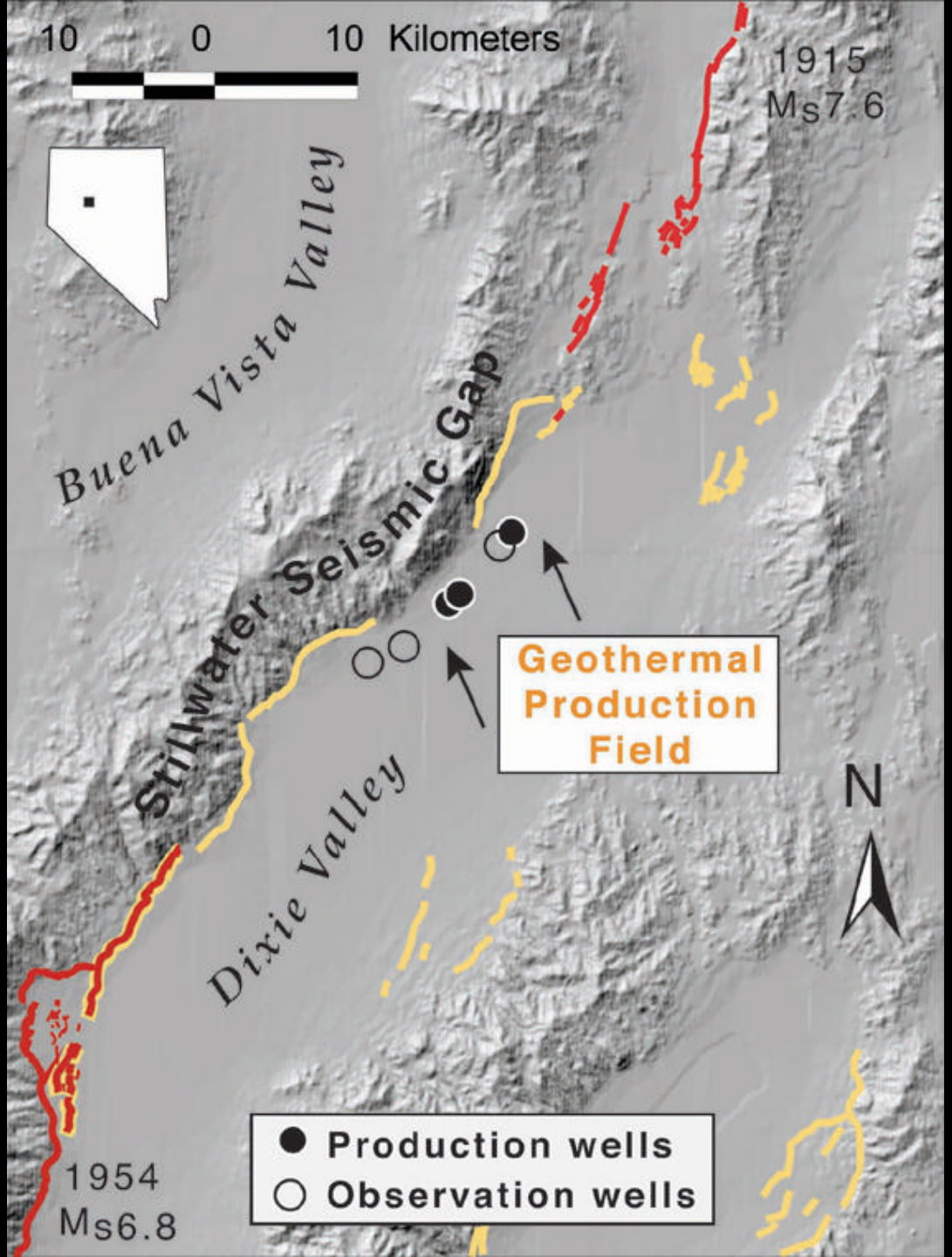
for $\Delta P_f = 0$,

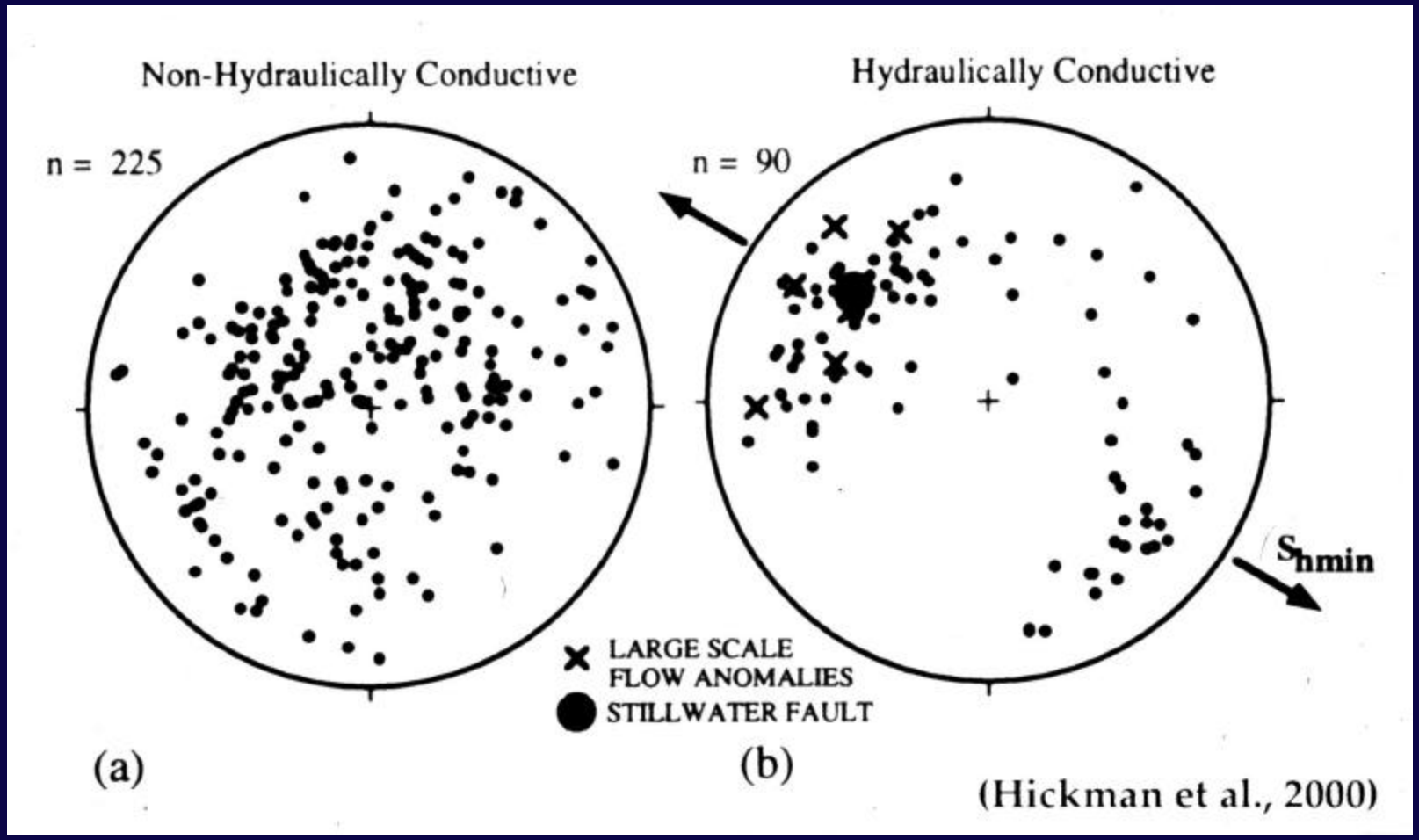
$$\Delta CFF = \Delta\tau_s + \mu_s(\Delta\sigma_n)$$

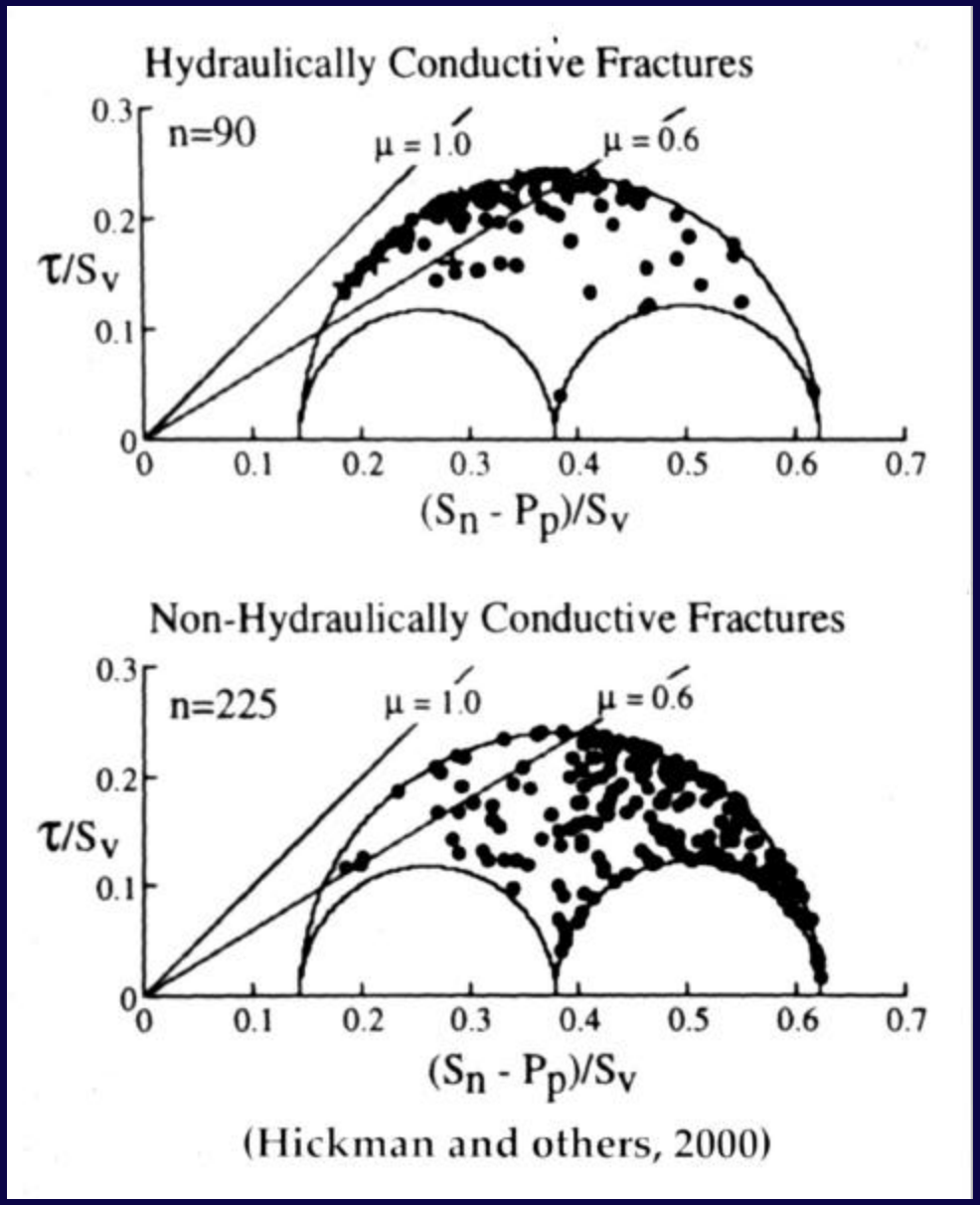
$\mu_s = 0.0, 0.75$


Horizontal grid, 5km depth
Holocene Ruptures
Dixie Valley Geothermal field
N
Holocene Ruptures
Distance (km)
Distance (km)
0
20
40
60
0
20
40
10
4
0
-4
-10
Coulomb failure stress (bars)
(Due to slip on Holocene faults)


Cottonwood
Cyn
76A-7
45-33
A
B
C
0
2
4
6
$\Delta\tau_s + \mu(\Delta\sigma_n)$
$\Delta\tau_s$ only
$\mu(\Delta\sigma_n)$ only
0
2
4
6
8
10
Distance along 040° strike (km)
18
15
12
9
Coulomb failure stress (bars)
(due to slip on Holocene fault ruptures)
Views from SE onto Dixie Valley fault plane (DVGF)


10 0 10 Kilometers
1915
Ms7.6
Buena Vista Valley
Stillwater Seismic Gap
Geothermal
Production
Field
Dixie Valley
N
1954
Ms6.8
Production wells
Observation wells


Non-Hydraulically Conductive
Hydraulically Conductive
n = 225
n = 90
S_{hmin}
LARGE SCALE FLOW ANOMALIES
STILLWATER FAULT
(a)
(b)
(Hickman et al., 2000)



(Hickman and others, 2000)

Conclusions:

- the MRE along DVF occurred ~3.4-2.0 kyrs B.P. but did not rutpure through the DVGF
- production fields don’t necessarily lie along the most recently active sections of the fault
- stress induced near the endpoints of fault ruptures promote failure stress and fracture permeability along unruptured adjacent sections of the faults
- an integrated approach using field studies of active faults and stress analyses is necessary to characterize the neotectonic framework of geothermal fields in the Basin and Range and may have excellent potential for geothermal exploration